Project 50073

# VAPOR RECOVERY SYSTEMS AT GASOLINE DISPENSING FACILITIES
# ON-BOARD VAPOR RECOVERY EFFECTS

## ORVR RETEST WORK PLAN

Prepared for:

California Air Resources Board
Research Division
2020 L Street
Sacramento, CA 95814

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# SECTION 1

# INTRODUCTION

As part of the process to evaluate the impact of on-board vapor recovery (ORVR) equipped vehicles on the emission signature of gasoline dispensing facilities (GDF), the California Air Resources Board (ARB) is executing a retesting of the ORVR impact field measurements collected during the Winter of 1998 at numerous Northern California GDFs. The specific test locations for the retesting will be located in Sacramento and El Sobrante, California. The two retest field measurement programs are scheduled to take place during the month of July, 1998. Each site-specific test period will take approximately 21 days. The field study will include the following components:

- Field management and coordination.
- Selection and use of gasoline dispensing facilities (GDF) as field test sites.
- A field measurement program consisting of two field test vans that will execute hydrocarbon, pressure, volume and temperature measurements at the vent line riser of the site-specific vapor recovery system (VRS) at GDFs.
- One field test van that will execute ARB's certification and test procedures (C & TP) for measuring static and dynamic pressure and air/liquid ratios for GDF vapor recovery systems.
- Quality assurance.
- Data management and analyses.

AeroVironment Environmental Services Inc., AVES, has been contracted by ARB to perform the study design, field measurement program, data processing and reporting for this program. This test plan describes the measurement program to be performed by AVES.

## 1.1 RETEST PROJECT OBJECTIVES

This field measurement program is a continuation of research project designed to evaluate the interaction between ORVR-equipped vehicles and vapor recovery systems (VRS) at gasoline dispensing facilities (GDF). Specifically, the research project will determine whether ORVR-equipped vehicles increase or decrease GDF emissions as a function of VRS design. There are two objectives for the retest field measurement program:

1. Develop, validate and execute methods for simulating the refueling of ORVR-equipped vehicles at GDFs equipped with Gilbarco and Wayne vacuum assist VRS.

2. Determine what impact the refueling of ORVR-equipped vehicles has on existing emission profiles for Gilbarco and Wayne vacuum assist VRS.

## 1.2 SCOPE OF WORK

There will be two tasks for this project: the ORVR simulation model task and the ORVR impact test series task. Each task has unique objectives. However, the ORVR simulation methodology (i.e., physical device) developed in the ORVR simulation task will be used to simulate ORVR equipped cars in the ORVR impact test series task.

## ORVR SIMULATION MODEL TASK

The ORVR simulation model task is designed to develop physical models or VRS dispenser modification methodologies that can be used to simulate ORVR refueling events at GDFs. Implicit in this process are two assumptions addressing the expected efficiency of ORVR as a hydrocarbon control strategy: (1) ORVR system seals will not allow any hydrocarbons to escape to the atmosphere at the fillpipe-dispensing nozzle interface; and (2) only air will be returned to the underground storage tank (UST) when ORVR equipped cars are refueled at GDFs. The objective of the ORVR simulation model test series is:

1. Develop physical models (i.e., devices) or VRS dispenser modification methods that will allow simulation of refueling events for ORVR-equipped cars at GDFs equipped with Gilbarco and Wayne vacuum assist VRS.

### *Device or Methodology Development to Simulate ORVR Equipped Vehicle Refueling at Gilbarco and Wayne Vacuum Assist Vapor Recovery Systems*

A physical model (i.e., “a device”) or a VRS dispenser modification methodology will be designed (and fabricated or procured in the case of an actual physical model) that will allow the simulation of refueling ORVR-equipped cars at GDFs equipped with Gilbarco and Wayne vacuum assist VRS. The ORVR simulation method for Gilbarco and Wayne vacuum assist VRS will be designed so only air is returned to the UST during the refueling event. In addition, the ORVR simulation device must adhere to the following requirements:

1. Allow fuel to enter the fillpipe during refueling.
2. Prevent the flow of vapor to the UST.
3. Control the flow of air into the vapor return line of the VRS.
4. Provide the same back-pressure:flow ratio as is found in an unmodified vacuum assist VRS.
5. Provide the same air:liquid ratio as is found in an unmodified vacuum assist VRS.
6. Provide the same liquid blockage removal performance as is found in an unmodified balance VRS.

Functions 1-3 will be realized by the design criteria for the ORVR simulation methodology. Functions 4-6 will be confirmed using ARB test procedures TP-201.4, TP-201.5 and TP-201.6. The BAAQMD will execute these tests. The ORVR simulation methodology will be assumed to meet functions 4-6 when the average performance values of the ORVR simulation methodology agrees with the performance values generated for unmodified vacuum assist nozzles, accounting for the experimental uncertainty and variation. The location of the ORVR simulation methodology testing will be at the same vacuum assist GDFs to be used for the ORVR impact field measurement program.

During the initial ORVR impact test series that was executed from January-May 1998, a physical model for ORVR simulation was developed for the Wayne VRS. In addition, a VRS dispenser modification methodology was developed for the Gilbarco VaporVac vacuum assist system. The same ORVR simulation methods will be used in the retest ORVR impact field studies. A description of each of these ORVR simulation strategies is provided in Section 4.1.

## ORVR IMPACTS TEST SERIES TASK

The primary goal of the ORVR impact test series is to directly quantify the effects that ORVR-equipped cars will have, in combination with Gilbarco and Wayne vacuum assist VRS, on GDF vent and fugitive hydrocarbon emissions. Two types of VRS will be evaluated. Tables 1-1 and 1-2 tabulate the VRS types to be used in the ORVR impact test series. VRS system type will be the primary independent variable for this test series and vent/fugitive emissions will be the dependent variable. The location of the test sites will be in Sacramento, California for the Wayne system and in El Sobrante, California (in the east San Francisco Bay area) for the Gilbarco system. Testing will occur during July, 1998. The specific schedule is illustrated in Section 9 (Table 9-1) in this document. Ambient temperature and pressure conditions and summer fuel will be the secondary independent variables influencing vent and fugitive emissions variance.

**Table 1-1**
**Vapor Recovery System Test Conditions**

| Test Mode | VRS Type | P/V Valve At End of Vent Line | Assist Pump Location | Bell | Incinerator |
|---|---|---|---|---|---|
| 1 | Gilbarco Vacuum Assist | Yes | Dispenser | No | No |
| 2 | Wayne Vacuum Assist | Yes | Dispenser | Yes | No |

**Table 1-2**
**Vapor Recovery Specifications**

| VRS Type | Manufacturer | Nozzle |
|---|---|---|
| Gilbarco Vacuum Assist | Gilbarco VaporVac AL121OC<br>(Executive Order 70-150) | OPW11 VAI-27<br>Emco Wheaton 4505<br>Husky V3 |
| Wayne Vacuum Assist | Dresser Wayne<br>(Executive Order 70-153AC) | OPW11 VAI-69<br>Emco Wheaton 4505<br>Husky V34-6250 |

### *Vent and Fugitive Emissions at Vacuum Assist VRS Equipped GDFs*

Vent and fugitive emissions will be measured at the Gilbarco and Wayne vacuum assist VRS equipped GDFs identified as test modes 1 and 2 in Table 1-1. The field test locations are tabulated in Table 4-1. Prior to the initiation of the field emissions test, a one-week record of nozzle product throughput will be evaluated. These data will used to identify nozzles which have sufficient product throughput to achieve the single test case criteria identified in Table 1-3. In this test case, the ORVR simulation device(s) or methodologies will be integrated into the dispensers required to meet the 50% per cent gasoline dispensed through the ORVR simulation dispensers. This represents 50% ORVR penetration into the vehicle fleet.

Concurrently with the hydrocarbon measurement procedures, refueling 1998 calendar year automobiles equipped with ORVR will be cataloged using the list contained in Appendix D as a frame of reference.

**Table 1-3**
**Criteria for ORVR Simulation Test Cases**

| Test Case | % of Gasoline Dispensing to ORVR Equipped Cars |
|---|---|
| 1 | 50% |

Vent and fugitive emissions will be measured continuously for two weeks without the integration of the ORVR simulation devices into the dispensers. This measurement period will be known as the baseline test series. Following the baseline test series, the ORVR simulation devices will be installed into the Gilbarco and Wayne dispensers. Upon installation, vent and fugitive emissions will be measured continuously for 96 hours. This measurement period will be known as the ORVR simulation test series. For both test series, vent emissions will be measured using a modification to Certification and Test Procedure (C&TP) ARB TP-201.2. In addition, for both test series, fugitive emissions will be quantified using the draft C&TP ARB TP-201.2B. Section 4 describes in detail the vent and fugitive measurement methodologies.

Prior to, and immediately after the emissions testing, the Bay Area Air Quality Management District (BAAQMD) source test staff will assay GDF static pressure, dynamic back pressure, and air:liquid (A/L) ratios using the methodology specified in BAAQMD Methods ST-30, ST-27 and ST-39 respectively. The baseline test series cannot proceed until each of the two field test sites conforms to the requirements of BAAQMD Methods ST-30, ST-27 and ST-39 for static pressure, dynamic back pressure, and A/L. For ST-39, the observed pre-test A/L values must conform to the 75$^{th}$ percentile. If the post-test ST-30, ST-27 and ST-39 values do not adhere to the method requirements, each non-compliance value will be evaluated on a case by case basis. If the reason of non-compliance if deemed critical to the validity of the vent or fugitive emission dataset, the baseline and ORVR simulation test series will need to be repeated until the pre-and post-test ST-30, ST-27 and ST-39 values adhere to the method requirements. The emission results will be expressed as pounds of hydrocarbon emitted per 1,000 gallons of gasoline dispensed.

***Development of Emission Factor Models for GDFs***

The emissions data collected in both the baseline and ORVR simulation test series will be used to derive two emission factor models for each of the two types of vacuum assist VRS evaluated. The independent variable is the percent of gasoline dispensed to ORVR equipped vehicles and the dependent variable is GDF vent and fugitive emissions. Given that fugitive emissions will vary as a function of UST pressure, is may be necessary to have emission factor models for several UST pressure values. Each model will predict hydrocarbon emissions from each facility in pounds per hydrocarbon emitted per 1,000 gallons dispensed as a function of the percent gasoline dispensed into ORVR-equipped vehicles. Each will address the following emission sources:

- Vent emissions as a function of VRS type.
- Fugitive emissions as a function of VRS type.

- ORVR canister hydrocarbon losses which will be assumed to be 5% of uncontrolled transfer emissions as specified in the project RFP.

The independent dependent variable relationship will be evaluated in terms of whether it is linear or nonlinear.

## SECTION 2

## ORGANIZATION AND RESPONSIBILITY

The organization chart for this project is presented in Figure 2-1.

Dr. Robert Grant is the ARB contract officer for this project.

Dr. David Shearer will serve as AVES's project manager. He is responsible for the overall operation of AVES program. In addition, he is charged with crafting the study design and test plan documents, overseeing the field study and data analyses phases of the project, and drafting the project final reports.

A technical advisory panel (TAP) will provide technical review of project milestones. The TAP membership consists of the following individuals:

- Robert Grant, ARB
- James Loop, ARB
- Cynthia Castronova, ARB
- Laura McKinney, ARB
- Ken Kunaniec, CAPCOA
- Dave Good, USEPA
- Glen Passavant, USEPA
- Don Gilson, Western States Petroleum Association (WSPA)
- Harold Haskew, American Automobile Manufacturing Association (AAMA)

Mr. Vulker Druenert of Druenert Engineering will be the manager of field measurement program. He will be responsible for the set-up and operation of the monitoring sites. This includes overseeing the field test vans and executing the hydrocarbon, pressure, temperature, and flow measurement and data acquisition procedures as defined in Section 4 of this work plan. He is also responsible for overseeing the calibration of the VRS and meteorological monitoring equipment. Mr. Druenert will also execute the data analysis procedures as defined and designed by Dr. David Shearer.

SABER Technologies L.L.C. and the ARB Source Test Section will each provide a test van for one of the test sites. The SABER test van will be used for the Gilbarco site and the ARB test van will be used for the Wayne test site. Both SABER and ARB will provide a test engineer that will oversee the respective test van instrumentation. Mr. Vulker Druenert will be the second engineer for each of the test vans

The BAAQMD source test staff will execute the pre- and post-test static pressure, dynamic pressure and A/L tests. They will be assisted by a single CARB staffer at each location and an authorized service representative from either Gilbarco or Wayne, or from Chevron (the Wayne site) or Shell (the Gilbarco site).

A CARB staffer will be present at each test site for both the baseline and ORVR simulation test series. Their role will be oversight.

The performance and system audit responsibilities will be performed by Mr. David Bush, AeroVironment's manager for quality assurance.

Dr. David Shearer of AeroVironment and Ms. Alison Pollack from ENVIRON are responsible for designing the data statistical analyses.

## SECTION 3

## QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

### 3.1 INTRODUCTION

The Quality Assurance Project Plan defines the data quality goals for the project and the quality control activities necessary to obtain them. These goals are stated in terms of precision, accuracy and completeness. Quality Assurance (QA) is defined as independent assessments of the effectiveness of the measurement program and the quality assurance procedures employed. This includes both performance and system audits. Quality Control (QC) is defined as the operational procedures used to evaluate whether a measurement process is generating valid data. This includes periodic calibrations, duplicate checks, zero-span checks and review of the data for reasonableness and consistency. QC procedures are used to document claims of accuracy.

### 3.2 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

Table 3-1 delineates the QA objectives for all field activities that generate data. These objectives are presented in terms of accuracy, precision and completeness. The Environmental Protection Agency (EPA) defines these terms as follows:

- Accuracy is the degree of agreement between the measurement or the average of measurements for a parameter and the accepted reference or true value. It is the combination of the bias and precision in a measurement system.

- Precision is the measure of mutual agreement among individual measurements of the same property.

- Completeness is the measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained.

**Table 3-1**
**Quality Assurance Objectives**
**Field Measurement Program**

| Equipment | Accuracy | Precision | Data Completeness |
|---|---|---|---|
| **Temperature** | | | |
| Ambient Temperature K-type thermocouple | 0.2 °F | 0.2%. | 85% |
| VRS Temperature K-type thermocouple (Omega) | 0.2 °F | 0.2%. | 85% |
| | | | |
| **Pressure** | | | |
| VRS Pressure Transducers* (Omega, Dwyer & Viatram) | ±0.50% | 0.10% | 85% |
| Ambient Pressure* Transducers (Sensyn) | ±0.50% | 0.10% | 85% |
| | | | |
| **Vapor Volume** | | | |
| McMillian 100 Flo-Sen* | ±3.0% | 10% | 85% |
| Wayne Roots Meters* | ±3.0% | 10% | 85% |
| | | | |
| **Hydrocarbon Measurement** | | | |
| Infrared Industries NDIR* (SABER Van) | 10% | 10% | 85% |
| Rosemount GC FID* (SABER Van) | 10% | 10% | 85% |
| Beckman 400 GC-FID* (ARB Van) | 10% | 10% | 85% |
| OSC/Altamont 702D NDIR* (ARB Van) | 10% | 10% | 85% |
| | | | |

* - Relative to full scale

## SECTION 4

## MONITORING PROCEDURES

AVES, in collaboration with SABER Technologies L.L.C., ARB, and the Bay Area Air Quality Management District, will execute the GDF retest measurement program. The measurement program is designed to conform to the requirements of the study design document and the ARB C&TPs. The C & TPs specify that hydrocarbon, pressure, temperature, and flow measurements will be executed at three locations on the site-specific Phase II vapor recovery systems: the nozzle/vehicle interface, the product dispenser return vapor line and the UST vent riser. The retest measurement program will sample at only one of the three sample locations :

- The outlet for the underground storage tank vent line at the top of the vent line riser.

In addition, for this project, the draft C & TP for fugitive emissions will be executed. The fugitive emissions C & TP is intended to:

- Estimate the amount of fugitive emissions leaving site-specific vapor recovery systems as a function of facility pressure profiles.

The following discussion describes how the test sites were chosen, how the ORVR simulation methods are operationalized, and the how the parameter-specific measurements will be executed.

### 4.1 GASOLINE DISPENSING FACILITY SITE SELECTION PROTOCOL

The criteria for selecting the GDF measurement sites included the following characteristics:

- Proximity to both Sacramento and the San Francisco Bay area. The agreed upon locations are in the east San Francisco Bay Area within 75 miles of Sacramento and in the metropolitan Sacramento area.
- A product throughput of at least 100,000 gallons per month (> 16 nozzles).
- The presence of tank level monitors on the GDF underground storage tank or a computerized tracking system for product volume.
- The site has either a Gilbarco VaporVac or Wayne Vista vacuum assist VRS.
- The sites are distributed evenly across the membership of the Western States Petroleum Association member companies.

Based on these criteria, Table 4-1 lists the sites that will be used for the field study.

**Table 4-1**
**Field Test Locations**

| Vapor Recovery System Type | WSPA Member Company Site Number | Location | Vacuum Assist Trade Name |
|---|---|---|---|
| **Gilbarco Vacuum Assist** | Shell | 3621 San Pablo Dam<br>El Sobrante, CA | Vapor Vac |
| **Dresser Wayne Vacuum Assist** | Chevron | 4221 Raley Boulevard<br>Sacramento, CA | Vista |

## 4.2 ORVR SIMULATION METHODOLOGIES

In lieu of developing a universal device for each the vacuum assist systems to be evaluated, an engineering solution was developed that was unique to each of the vacuum assist vapor recovery systems based on their design and functional attributes. This was done in consultation with the chief engineer for each vapor recovery system manufacturers: Gilbarco and Wayne. Prior to using each ORVR simulation device, the simulation method will be reviewed and sanctioned by ARB and the project advisory panel.

### 4.2.1 Gilbarco Vacuum Assist Systems

The Gilbarco Vapor Vac equipped dispenser will be modified to allow the selected hose to flow fuel while an adjunct, inoperative nozzle's vapor path will be opened thus allowing the idle nozzle to ingest ambient air. This will be executed by purposely misconnecting the electrical wires leading to the solenoid operated vapor valves (which are normally in the normally closed position) found in the upper housing of Gilbarco dispensers. When properly connected under normal operating conditions, the selected hose will flow fuel and the matching vapor valve will open to provide a path in the coaxial hose for the returning fuel vapors. For the ORVR simulations, the vapor valves will be misconneted allowing fuel to flow in the selected nozzle but preventing the ingestion of vapors during the refueling event. This process will allow refueling of only the selected product grade (i.e., regular). Pumping of the other two products (89 and 92 octane) will not be possible given the misconnection in the electronic vapor valve assembly.

### 4.2.2 Wayne Vacuum Assist Systems

For the purposes of modeling ORVR equipped cars, a solenoid valve open to atmosphere will be attached to the return vapor line in the base of the dispenser. This disables any refueling car vapors from being shunted into the UST during the refueling event. The solenoid valve will be activated into an open position when the selected product lever is placed into the refueling position by the refueling customer. In the open position, the solenoid valve will allow fresh air to be fed into the UST during the refueling event. The solenoid valve will close within three seconds of the discontinuation of the fast flow coil circuit at the end of the refueling event. As a result of the ORVR simulation, only the desired product (i.e., regular grade) will be operational for the modified dispenser. The other two products (89 and 92 octane) can not be pumped by the refueling customer.

## 4.3 METEOROLOGICAL MEASUREMENTS

At each site, ambient meteorological measurements will be data logged continuously during the retest measurement program. The location of the meteorological instrumentation will be in close proximity to the field test van to facilitate data logging ease. However, recognizing potential interferences from the field test van, the meteorological tower will be far enough away to minimize external interferences.

Ambient temperature values will be assessed using an Omega K-type thermocouple probe integrated with an Action Instruments TC temperature signal conditioner (Model 4351-2000). A K-type thermocouple functions by measuring the resistance across a thermocouple probe with a 0-5 volt scale. The temperature signal conditioner is a pulse accumulator which conditions the temperature resistance signal. A temperature value will be recorded every second and fed into the data acquisition system.

Ambient pressure will be recorded using a Sensyn Model LM1801 absolute pressure transducer. As with temperature, a pressure value will be determined every second and will subsequently be data logged..

## 4.4 HYDROCARBON MEASUREMENTS

The hydrocarbon measurements will be performed based on modifications to the procedures specified in ARB C & TPs. For this project, there are two relevant certification and test procedures:

**TP-201.2** - Determination of Efficiency of Phase II Vapor Recovery Systems of Dispensing Facilities: The purpose of this test procedure is to determine the percent vapor recovery efficiency for a vapor recovery system at a GDF. The percent vapor recovery efficiency is the percent of vapors displaced by dispensing which are recovered by a vapor recovery system rather that emitted to the atmosphere.

**TP-201.2B** - Determination of Flow Versus Pressure for Equipment in Phase II Vapor Recovery Systems of Dispensing Facilities: The purpose of this test procedure is to determine The fugitive emissions and the vapor recovery efficiency at GDFs. The mass flux of fugitive emissions from a dispensing facility is the product of the volumetric flow rate and the flow-weighted mass per volume concentrations. The volumetric flow rate is based on data for pressure vs. time from the facility and data for flow vs. pressure from a model of the facility. The model flow vs. pressure data are to provide a conversion for the facility pressure vs. time data to flow vs. time data.

TP-201.2 will be are executed at the two field test locations and TP-201.2B will be executed in both the field and as a bench top laboratory experiment with site-specific pressure signatures provided by the BAAQMD performance tests.

The modified TP-201.2 C&TP will consist of a sample manifold attached to the top of the vent line riser. The manifold will be constructed of PVC tubing and will contain a perforated sample coil inside the manifold. The sample manifold will include in the following upstream to downstream order (Figure 4-1):

- A bench tested Husky Model 4620 pressure/vacuum valve.

•A temperature sample port.
•A pressure sample port.
•A hydrocarbon sample port for vent emissions.

Upstream from the sample manifold, the following sample ports and/or devices will be installed on the vent line riser in an upstream to downstream order of:

•A UST pressure sample port.
•A hydrocarbon vapor sample port for the fugitive emissions test.
•A roots meter

The sample manifold will be bench tested for collection efficacy prior to installation on the vent line riser. The manifold efficacy test will consist of procedure that will add a known hydrocarbon concentration (as propane) at a known flow rate into a capped manifold. The know hydrocarbon concentration will be compared to the measured hydrocarbon concentration having adjusted for temperature, pressure and flow.

The fugitive emissions hydrocarbon sampling methodology will consist of drawing three grab samples per week into two liter SUMMA canisters for both the 14 day baseline test series and the four day ORVR impact test series. Vent emissions sampling methodology will consist of a continuous sample stream being pulled out of the hydrocarbon sample port for vent emissions at a flow rate of at least 100 liters per minute. The flow rate will be measured using a MacMillian paddlewheel flowmeter. The purpose of high flow rate is to ensure that all vapors emitted downstream of the P/V valve will be captured and drawn into the sampling system. The sample stream will be continuously monitored (one value per second) for total volatile organic compounds measured as propane using a high range nondispersive infrared analyzer (NDIR) and a low range flame ionization detector (FID).

### 4.4.1 Analytical Procedures for TP-201.2

As specified in the C & TPs, the vent line and fugitive hydrocarbon measurement analytical methodologies will be performed according to EPA reference method 25A and 25B. EPA Method 25A describes the determination of total gaseous organic compound emissions using a FID analyzer and EPA Method 25B specifies the determination of total gaseous organic compound emissions using a NDIR analyzer.

The principle of operation for the flame ionization detector method (EPA 25A) is that a hydrocarbon gas sample is extracted from the source through a sample line and a glass fiber filter to a flame ionization analyzer. Results are reported as volume concentration equivalents of the calibration gas or as carbon equivalents. The principle of operation for the nondispersive infrared method (EPA 25B) is similar. A hydrocarbon gas sample is extracted from the source through a sample line and a glass fiber filter to a nondispersive infrared analyzer (NDIR). analyzer. Results are also reported as volume concentration equivalents of the calibration gas or as carbon equivalents.

The specifications of the hydrocarbon analyzers to be used for this project are tabulated in Table 4-2. Based the specifications defined in TP-201.2, the primary distinction between the sample trains for the FID and NDIR analyzers is that the hydrocarbon sample stream from the NDIR is returned unaltered from the NDIR outlet to the sample manifold.

**Table 4-2**
**Hydrocarbon Analyzer Specifications**

| Instrument Model Number | Analytical Method | Test Van | Operating Range (% or ppm as $C_3$) | Use |
|---|---|---|---|---|
| Beckman 400 | FID | ARB | 0-400 ppm,<br>0-4000 ppm,<br>0-40,000 ppm<br>0-100% | Low Range<br>Low Range<br>Low Range<br>High Range |
| Rosemount Model 400A | FID | SABER | 0-10% | Low Range |
| OSC/Altamont 702D | NDIR | ARB | 20-5000 ppm<br>0-5%<br>20-100% | Low Range<br>Low Range<br>High Range |
| Infrared Industries Model IR-8402 | NDIR | SABER | 0-80% | High Range |

As previously mentioned, the duration of the hydrocarbon assessment procedures for each vapor recovery system type will be 14 days for the baseline test series and four days for the ORVR impact test series.

The hydrocarbon data will be data logged into the data acquisition system with a data point collected every second from each of the hydrocarbon analyzers.

### 4.4.2 Analytical Procedures for TP-201.2B

The objective TP-201.2B is to estimate site-specific fugitive emissions by determining the flow leaving the facility as a function of VRS pressure signatures. Fugitive emission sources include UST vent lines equipped with P/V valves, “closed” idle nozzle check valves and “closed” overfill drain valves.

Several parameters need to be quantitatively measured to produce a value for fugitive mass flux including:

- Facility VRS volumetric leak flow rate
- Facility VRS pressure profiles
- Hydrocarbon concentrations (hydrocarbon mass/volume of hydrocarbon emitted
- Facility VRS temperate profiles

To generate the pressure and flow values, the Bay Air Quality Management District will execute two inch static pressure performance tests (C & TP TP-201.3) at each field test sites. This procedure pressurizes the entire vapor recovery system to two inches water column. After five minutes, the VRS pressure is noted and compared to allowable levels. Using standard engineering principles, the volumetric leak flow rate can be calculated. This value, coupled with the flow-weighted hydrocarbon mass per volume concentration yields the mass flux of fugitive emissions leaving the GDF for the TP-201.3 pressure conditions.

Hydrocarbon concentrations (mass/volume) will be assayed at the fugitive emissions test port using SUMMA canisters as the collection medium and NDIR as the analytical methodology.

Facility pressure and temperature profiles will be collected during the execution of TP-201.2 at the vent line riser for representative facility operating conditions. These include maximum and minimum facility throughputs and product bulk drops.

To model the facility, a piece of capped PVC pipe will be pressurized using bottle nitrogen. A small hole will subsequently be added to the PVC pipe such that the flow out that hole equals the site-specific leak flow rate as a function of pressure (as determined by TP-201.3). Having established the facility model, volumetric leak flow rates will be determined for the time dependent pressure profile conditions found at each field test sites. These data will then be coupled with the hydrocarbon mass/volume data to produce an estimate of field test site-specific hydrocarbon fugitive emissions.

## 4.5 PRESSURE MEASUREMENT

Based the specifications of TP-201.2, pressure readings will be taken at vent line riser concurrent with the hydrocarbon measurements. In addition, UST pressure readings will be logged continuously during the baseline and ORVR impact test series. . The specific locations of the pressure transducers on the sample manifold relative to the flow measurement devices (roots meter or flow meter) are noted in TP-201.2. In general, they are upstream from the hydrocarbon vapor flow devices. The pressure transducers that will be used are tabulated in Table 4-3.

**Table 4-3**
**Pressure Transducers**

| Transducer Make | Model | Range |
|---|---|---|
| Dwyer (SABER) | 603A-4 | 0-5 in. WC |
| Dwyer (SABER) | 603A-13 | ± 5.0 in. WC |
| Omega | PX654-50BD5V | ±0 10.0 in. WC |

### 4.5.1 <u>Analytical Procedures for TP-201.2</u>

As is apparent from Table 4-3, a range of differential pressure transducers will be available for the field technicians. The specific transducer that will be used will depend on the vapor recovery system pressure profile at the time of the test. The pressure values will be recorded every second and data logged using the test van data acquisition systems.

## 4.6 TEMPERATURE MEASUREMENT

Based on the specifications of the study design document and the relevant C & TPs, hydrocarbon vapor temperature will be continuously recorded at the vent line riser.

### 4.6.1 <u>Analytical Procedures for TP-201.2</u>

Temperature will be measured using Omega K-type probes integrated with an Action Instruments TC temperature signal conditioner (Model 4351-2000). A K-type thermocouple probe functions by measuring the resistance across a thermocouple with a 0-5 volt scale. The temperature signal conditioner is used to convert the thermocouple probe analog output into a digital signal that can be input into the field test van data acquisition system. The range of the K-type thermocouple probe is 0-200 °F. The specific locations of the thermocouples probe on the sample manifold relative to the flow measurement devices (ROOTS® meter or flow sensors) are noted in TP-201.2. In general, they are upstream from the hydrocarbon vapor flow devices. A temperature value will be recorded every second and fed into the data acquisition system.

## 4.7 VOLUME MEASUREMENT

Pursuant to the C & TPs specifications, the volume of hydrocarbon vapor will be measured at the vent line riser upstream from the P/V valve using a rotary positive displacement gas volume meter (e.g., ROOTS® meters). In addition, a turbine flow sensor will measure sample stream flow downstream from the P/V valve.

### 4.7.1 Analytical Procedures for TP-201.2

A ROOTS® rotary positive displacement gas meter will be used to quantify hydrocarbon vapor volume upstream from the P/V valve. The ROOTS® meter that will be used is a Dresser Model 3M175. The ROOTS® meters volume measurements will be electronically logged using a solid state pulser that transmits 100 pulses per revolution (where one revolution equals 1 cubic feet). Pulses will be totaled using an Action Instruments pulse accumulator which provides an operating range of 0-4180 pulses full scale. These values will be data logged using the field test van data acquisition system. During data processing, the hydrocarbon vapor volumes will be corrected for temperature and pressure based on the ambient temperature and pressure data collected concurrent with the C &TP test series.

A MacMillian 100 Flo-Sen turbine flow sensor will be used to measure hydrocarbon vapor volume downstream for the P/V valve. The range of the flow sensors is 0-100 liters per minute. The principle of operation for the flow sensors is that a Pelton type turbine wheel is used to determine the flow rate of the hydrocarbon vapor. As the turbine wheel rotes in response to gas flow rate, electric pulses are generated. Processing circuitry provides a D.C. voltage output (0-5 V) that is proportional to flow rate. This voltage output signal will be data logged each second and stored in the field test van data acquisition system. For these test points, vapor recovery system pressure and temperature will be measured at the inlet of the flow sensor. The hydrocarbon sample will be collected at the outlet of the flow sensors.

## 4.8 DATA ACQUISITION SYSTEMS

All of the collected independent and dependent measure parameters will be data logged at one second intervals using a personal computer (PC) based data acquisition system. The PC is equipped with a 75 megahertz Pentium CPU processor and a standard I/O board (Model C10-DAS1-602/16 made by Computer Board) with 16 single ended channels The data logging computer software is Laboratory Notebook. In addition to PC base data acquisition, strip chart records will also be used to record the continuous independent and dependent variables.

## 4.9 PRE-TEST AND POST-TEST MEASUREMENTS (STATIC AND DYNAMIC PRESSURE AND A/L TESTS)

As specified in the retest test series study design, prior to and following the execution of the retest field measurement program, the site-specific vapor recovery systems will be evaluated for ARB specified performance. These tests will determine if the VRS are functioning according to manufacturers design and ARB mandated performance specifications. Three performance tests will be executed by Bay Area Air Quality Management District (BAAQMD) source test staff who are specially trained to execute these tests. The tests and their respective ARB designations are listed in Table 4-5.

**Table 4-5**
**ARB Performance Tests**

| Variable | Measurement Methodology |
|---|---|
| Static Pressure | ARB TP-201.3 |
| Dynamic Back Pressure | ARB TP-201.4 |
| Air/liquid Ratio | ARB TP-201.5 |

If the particular VRS that is being tested does not pass the performance tests before the hydrocarbon emission testing is initiated, the VRS will be serviced and retested to assure that it passes the most conservative specifications (i.e., upper $25^{th}$ percentile) for vapor recovery system performance.

The performance data for each of the performance tests will be logged onto ARB sanctioned data sheets and will later be included in the project final report. The site-specific pressure profiles will be used as input data to execute TP-201.2B, the fugitive emissions C &TP.

During the duration of the baseline and ORVR impact test series, daily A/L checks will be executed using a novel “bag test” procedure. A separate bag test exists for both the Gilbarco and Wayne VRS. In addition, a hanging hardware vacuum integrity test will be performed on the Gilbarco vacuum assist system using a device to be provided by the CARB.

At the conclusion of the ORVR impact test series, the VRS static pressure, dynamic pressure and A/L performance tests will be re-executed by the BAAQMD source test staff. If the VRS do not pass the minimum requirements, a case-specific evaluation by ARB Compliance staff will be executed. If it is determined that the non-compliance excursions have a serious impact on the test site emission profiles, the baseline and ORVR test series will be repeated. Conversely, if it is determined by the ARB Compliance staff that the noncompliance excursions do not have a significant impact on GDF emissions, the retest dataset will be deemed adequate.

### 4.9.1 <u>Analytical Procedures</u>

The analytical procedures for each of the performance tests are found in the ARB C & TPs.

## 4.10 SITE OPERATING PROCEDURES, QUALITY CONTROL CHECKS AND CALIBRATION

Field test site checks will be performed daily by the field test staff to ensure that the test equipment is properly installed and functioning correctly and that the field test van functioning according to design. The field staff will be trained for these procedures. Hydrocarbon analyzer zero-span checks will be performed several times per day. Calibration of the hydrocarbon analyzers will be performed at the beginning and end of each site-specific field program. Additional calibrations will be performed quarterly or when analyzers are repaired and reinstalled.

The meteorological sensors will be calibrated at the beginning of the field measurement program.

### 4.10.1 <u>Van Check Procedures</u>

Field test van checks will be performed during each site visit by the site technician following a format predesignated by the field site manager. The purpose of the field test van check is to ensure that the monitoring van is operating properly. This procedure gives warning of developing equipment problems and identifies instrument problems.

During each field test van check, the site technician visually inspects the meteorological sensors, the temperature, pressure, and flow probes, hydrocarbon inlet system (i.e., the sample manifold) and the hydrocarbon analytical equipment. The field test van has a bound logbook for notating field technician comments concerning the test van operation as well as maintaining a record of van maintenance activity.

### 4.10.2 <u>Quality Control Checks and Frequency</u>

The quality control checks include periodic operational checks of the field instruments by the site operator coupled with computerized data screening by the project data analysis team for outliers.

#### 4.10.2.1 Zero, Span and Precision Checks - Hydrocarbons

Each of the hydrocarbon analyzers will be subjected to a zero and span check on a daily basis (drift check every 2-3 hours). The zero and span check data will be reviewed daily by an Acurex data technician.

As specified in EPA Methods 25A and 25B, the FID and NDIR analyzers will be calibrated using primary gas standards of appropriate concentrations. Standards in excess of 9,000 ppm will be blended on-site using an Environs mass flow gas dilution system (Series 4000) plus research grade propane ($C_3$). Other sources of liquid propane may be used if they can be shown to be equivalent to research grade with reference to instrument response equivalency (i.e., within 2% of range for mid-level gas). The span gas concentrations are about 90 percent of the analyzer's nominal operating range. The measurement system performance specifications will be $\pm$ 3 percent of the span value for zero drift, and calibration drift and $\pm$ 5 percent for calibration error.. The frequency of calibration will be daily: prior to testing, two hours after the initial calibration was executed and at any time a calibration drift is evident. The OVA will be calibrated with a high range and 0 gas.

To perform zero and span checks, a zero concentration and one span concentration is introduced into each analyzer. The span gas concentrations are about 90 percent of the analyzer's nominal operating range. The analyzer operates in its normal sampling mode. The test gas passes through all filters, scrubbers, conditioners and other components used during normal sampling.

The zero and span data are used to determine whether the analyzer is in need of adjustment and to evaluate the validity of the data obtained. The following criteria are used in evaluating the data:

Zero checks-As part of the quality control checks, the daily zero checks should be within ±3% of full scale from the zero value established during the calibration. If on two consecutive zero checks (at least one day apart) the zero is greater than this tolerance the instrument will be removed from service, the problem corrected, the instrument calibrated and put back on line. If the zero check exceeds 4% of full scale the instrument will be taken off line immediately, a "before" calibration performed, the problem with the instrument corrected and a new "after" calibration performed. If the zero check exceeds 5% of full scale, serious instrument problems are present with the monitor and/or calibration system. This is a threshold to invalidate data. The same action as the 4% criteria should be taken.

Span checks-As part of the quality control checks, the daily, or other interval, span checks (1.5 -2.5 times of the expected concentration) should be within ± 10% of span value established during the calibration. If on two consecutive span checks (at least one day apart) the span is greater than this tolerance the instrument will be removed from service, the problem corrected, the instrument calibrated and put back on line. If the span check exceeds 15% the instrument will be taken off line immediately, a "before" calibration performed, the problem with the instrument corrected and a new "after" calibration performed. If the span check exceeds 25%, serious instrument problems are present with the monitor and/or calibration system. This is a threshold to invalidate data. The same action as the 15% criteria should be taken.

Precision checks will performed at the beginning and end of the retest field measurement program using a span gas 20% of the hydrocarbon analyzer range. At least four different measurements will be taken. The mean and standard deviation of these values will be used to calculate the precision value.

#### 4.10.2.2 Temperature

Temperature quality assurance checks will be executed at the beginning and end of the retest field measurement program using a one point intercomparison between a field standard (a Campbell 107 naturally aspirated thermometer) and the K-type thermocouple probe.

#### 4.10.2.3 Pressure

Ambient pressure quality assurance checks will be executed at the beginning and end of the retest field measurement program using a one point intercomparison between a field standard (a portable altimeter) and the pressure transducer.

For each of the vapor recovery system pressure transducers that will be used in this study, a calibration check will be executed prior to and immediately following the test period in accordance to manufacturers specification.

#### 4.10.2.4 Volume

The flow sensors will be calibrated with the ROOTS® meter in the field test van and checked for proper running order at the onset, during the middle and at the conclusion of the testing for each field test location., The ROOTS® meters used for this project will be calibrated on an annual basis.

### 4.10.3 Calibration Procedures and Frequency

Calibrations establish data accuracy and data comparability by ensuring traceability of the transfer standards to higher quality standards such as the EPA reference calibration methods and NIST standards. They also verify instrument operation and response. The requirements for calibration of air quality instruments and meteorological equipment have been specified by the EPA (Quality Assurance Handbook for Air Pollution Measurement Systems, Vols. II and IV. EPA-600/4-77-027a, 1987, 1989). For some instruments, calibration standards have not been established and these are calibrated in accordance with AVES's experience.

The standard used to obtain test concentrations for hydrocarbons is specified in the Traceability Protocol for Establishing True Concentration of Gases Used for Calibration and Audits of Continuous Source Emission Monitors (Protocol No. 1) (June, 1978) published by the U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park. Working standards documentation is maintained in a central file at Acurex.

#### 4.10.3.1 Hydrocarbon Calibration Equipment and Procedure

Once a week, the hydrocarbon instrumentation will be calibrated before the daily zero and span checks with three gas concentrations: low-level (25-35% of applicable span value), mid-level (45-55% of applicable span value) : high-level (80-90% of applicable span value). The field technician will also recalibrate an analyzer whenever the zero, or span checks indicate that recalibration is necessary or whenever an instrument has been repaired or serviced. For meteorological instrumentation this interval is once every six months.

## 4.11 PREVENTATIVE MAINTENANCE

All aspects of maintenance are prescribed and performed according to manufacturer's specifications, which provides for regular, thorough maintenance of each instrument owned or operated by SABER and ARB. Full-scale maintenance of each instrument is performed at regularly scheduled intervals at SABER's and ARB's instrument shop in Sacramento. In addition, the site technician follows established procedures for regular maintenance, while the instrument is in the field.

All instruments were serviced prior to field deployment. Except for sample inlet filter changing, no routine instrument maintenance is required during the monitoring project.

### 4.11.1 Spare Parts Policy

SABER and ARB maintain a complete inventory of spare parts and equipment for this program at their Sacramento instrument facilities. SABER and ARB parts inventory is based on both manufacturers' recommendations and its own experience with equipment problems from both normal operation and vandalism-induced failure.

### 4.11.2 Training

The site technicians will be trained by the field manager in the following areas:

- Site and field test van check procedure and operation
- Equipment maintenance
- Record keeping

This training takes place partially through updates and changes to the standard operating procedures. Constant communication among the site technician and the Field Operations Manager is also invaluable to the training process.

## SECTION 5

## DATA REDUCTION, VALIDATION AND REPORTING

The objective of the data processing and validation effort is a quality assured data base containing the project monitoring data in a consistent format. The procedures that AVES has implemented for data processing and validation ensure that reported data are valid and comparable to those collected by federal, state and local air pollution agencies. These procedures meet the requirements and guidelines of the Environmental Protection Agency, e.g., Appendices A and B of 40 CFR 58; Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes I and II (1984, 1987b). Data processing procedures for this program are discussed below.

### 5.1 DATA BASE and PROCESSING

At the beginning of the project, before data are forwarded from the field, AVES's database coordinator, with the aid of the section manager, will create a project database directory. This directory will contain information specific to the project. A directory entry will be made for each of the parameter months of data on the database. The following information will be entered into the project-specific directory:

- project name
- site number(s)
- site name(s)
- component number (e.g., $O_3$=44201)
- reporting period
- status code
- units (ppm)
- reporting precision (specifies number of decimal places)
- outlier flags
- date of last access and update

In the field, data will be collected using data loggers with a capacity to store about two weeks of data. AVES San Francisco will retrieve the data every five days from the site-specific field staff. The polled data will be automatically screened for anomalies. Any anomalies will cause AVES's computer to alert data processing personnel to investigate.

Most data processing activities, including data screening and filtering, universal data editing and handling, data file indexing and protection will be conducted with the aid of AVESEDMS. The AVESEDMS database system has been tested and documented completely. AVES's data-processing staff includes a database coordinator dedicated to testing, maintaining, documenting, and controlling AVESEDMS. The following list summarizes some of the data processing and validation procedures that are handled automatically by application software and command language procedures.

- Outlier screening of data summaries
- Database loading of data
- Updating of on-line status files

- Database entry and editing
- Database access and process flow control
- Data flagging
- Data calibration (if required). Data are adjusted by applying the slope and intercept obtained from the linear regression of the appropriate calibration to the monitored data.
- Daily data backups
- Database creation and expansion
- Database archival and retrieval
- Creation of routine data summaries

The automation of these processes ensures that these steps will be performed in a consistent manner that minimizes the potential for processing errors.

Before they are loaded into the database, the data will go through an automatic screening program that will flag any anomalies. The screening routines will check all data for outliers, instrument problems, and data system problems. The screening program will test for data that exceed set minimums, maximums, and rate-of-change values. The data transfer will be reviewed routinely by data management personnel. Data that are lost can be recovered either from the data logger printouts or from the floppy diskette backups.

## 5.2 DOCUMENTATION AND DATA CUSTODY

All documentation and data pertinent to data processing will be collected by AVES from the field sites on a weekly basis. This will include site logs, checklist logs, zero/span checks, and multipoint calibration results. Data processing's procedures include checking the shipment for completeness and actions required.

Within one working day of receipt, each form of data and documentation will be logged separately in the incoming data log book for the project. These forms enable prompt identification of missing documentation and allow data clerks to track missing data.

If documents are missing (for example, if a checklist log has not been received from a specific site) or if any problems with the receipt of data arise, the project manager will be informed and he will take appropriate steps to recover the missing information (such as contacting the station operator). A correspondence file will be maintained in AVES's data library to ensure total program documentation; all documentation, including calibration records, data analyses, summaries and reports will be filed there. The data will be filed in appropriately labeled drawers and bins. Once the data and documentation have been received, logged in and filed, they will be available to the data technician to begin processing and validation procedures.

## 5.3 DATA VALIDATION

All data produced by this project are reviewed before use. AVES data validation procedures start with observations and reports made by the site operator and continue with review and analysis of all logs, checklists and data.

All flagged or anomalous data are investigated. Unless there is substantial evidence that suspect data are erroneous, these data will be retained. AVES's data processing procedures allow only the project's principal investigator (the project manager for this program) to invalidate data.

Zero and span check data for the hydrocarbon analyzers are reviewed routinely as part of the data validation effort. Data collected during periods when the span response deviates by more than 25 percent or the zero response deviates by more than 0.025 ppm from true values are invalidated. Data collected during periods when the span response deviates between 15 percent and 25 percent or the zero response deviates between 0.015 and 0.025 ppm are adjusted using correction factors obtained from the calibration and zero/span checks. The zero/span checks will be used to determine the affected period and the correction factors used to adjust the values.

All changes resulting from review of the documentation will be made directly on the raw data report and comments added as necessary to explain the changes. The raw data reports will be reviewed to ensure that all outliers have been corrected, replaced by the proper missing data code, or checked off as valid. Once the raw data have been completely checked, corrected and signed off by the quality control coordinator, changes will be made to the database and any necessary correction factors applied.

## 5.4 FIELD AND LABORATORY PROCEDURES USED TO ASSESS DATA ACCURACY, PRECISION, AND COMPLETENESS

Data collected during the program will be identified, validated, and reported. When data are reduced, the method of reduction will be described in the text of the report. Restraints on statistical inferences will be stated.

Pacific standard time will be referenced during data collection. All field measurement, meteorological, and laboratory data will be reported consistently, in accepted standard units.

The data will be assessed for accuracy, precision and completeness using the procedures described in the following subsections.

### 5.4.1 Accuracy

Accuracy is the difference between the analyzer response and the reference value obtained during the multipoint instrument audit.

$$\text{Accuracy} = \frac{Y - X}{X} \times 100$$

where: Y = analyzer value
X = the true concentration as determined by the audit.

### 5.4.2 Precision

Method precision will be determined from the weekly precision checks. The calculation to be used is provided in EPA (1987).

### 5.4.3 Completeness

For the field sampling and laboratory analyses, completeness is calculated as the ratio of acceptable measurements obtained to the total number of planned measurements. This ration does not include downtime due to routine zero span and precision checks, calibrations or audits. Loss of data due to these operations will be minimized to the extent possible through management of the time of when they take place.

# SECTION 6

# PERFORMANCE AND SYSTEM AUDITS

The objectives of an auditing program are to ensure the integrity of the data and to assess the accuracy of the data. Two types of audits are included in an auditing program: systems audits and performance audits.

A systems audit is an independent qualitative evaluation of the ability of an operation to generate quality data. Systems audits are conducted to evaluate all field, data processing, internal reporting, and analysis activities. A systems audit will be performed by a member of AVES's QA Department during the duration of the retest field measurement program. The auditor will check that standard procedures are being followed. Additionally, he will inspect copies of data, calibration factors, and problem reports to verify that correct protocols have been observed.

A performance audit is an independent quantitative evaluation of the quality of data produced by the total measurement system, including sample collection, sample analysis and data processing. It is an assessment of the measurement process under normal operations. A performance audit will be performed by an AVES QA engineer two weeks after the start of field sampling. The performance audit will include multipoint audits of all analyzers and measurement instrumentation. Audit results will be compared against the measurement goals for accuracy presented in the previous sections.

The audit procedures will conform to guidelines described in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes I (1984) and II (1987b). Procedures are discussed below. Other relevant guidelines are outlined in the EPA Ambient Air Quality Surveillance Regulations 40 CFR 58, Appendices A through E. All instruments and materials used to perform the audits will be traceable to the National Institute of Standards and Technology (NIST). A trained quality assurance engineer will perform each audit. Each member of the AVES quality assurance staff is experienced in on-site audits and in-the-field quality assurance procedures for air monitoring programs.

## 6.1 AUDIT EQUIPMENT

- **Dilution Systems**

The AVES QA Department designated audit calibration units are a Dasibi Model 5009 MC and a Dasibi Model 1009 MC dilution system. Mass flow rates are certified quarterly using a Meriam laminar flow element, which is a transfer standard for mass flow. AV's primary flow device is a NIST-certified Bubble-O-Meter. Both the Meriam and Bubble-O-Meter are housed in the AV QA standards laboratory in Monrovia, California. The audit calibration units are certified once per quarter.

- **Audit Span Gases**

Audit gases are analyzed in accordance with the Traceability Protocol for Establishing True Concentrations of Gases Used for Calibrations and Audits of Air Pollution Analyzers (Protocol No. 2), May 1987, in the EPA Quality Assurance Handbook for Air Pollution Measurement

Systems, Volume II, Section 2.0.7. All cylinders are recertified every six months. Cylinder gases used by AVES are supplied by Scott-Marrin, Inc., Riverside, California.

- **Ultrapure Air Cylinders**

Ultrapure air is used in the performance of the audits of the continuous THC and CO analyzers. Ultrapure air cylinders are obtained from Scott-Marrin, Inc. when the pressure in the cylinder currently in use drops to 300 $lb/in^2$. Each ultrapure air cylinder, with the exception of that used to audit the $CO_2$ analyzer, contains a concentration of 350 ppm $CO_2$ to simulate ambient air conditions.

- **Temperature Sensors**

Mercury-in-glass thermometers are compared to the AV QA department's NIST-traceable thermometer by an eight-point calibration before their first use in the field. All thermometers are referenced to this thermometer which is an NIST-traceable Brooklyn thermometer, Serial number 6D619. All field thermometers are recertified each year.

- **Laminar Flow Elements**

Laminar flow elements are maintained by AVES's Quality Assurance Department as a secondary standard. All laminar flow elements are certified annually by an external laboratory.

- **Meteorological Instrument Audit Equipment**

The device AV uses to audit horizontal and vertical wind speed sensing systems is an RM Young Model 18810 Selectable Speed Anemometer drive. Its rotational velocities are certified quarterly using a Cole-Parmer Model 8211 Phototach.

The wind direction boom alignment is checked with a Brunton Compass. There is no certification procedure for compasses. The compass is checked for damage before each use.

The relative humidity and dew point audit device is a Psychro-Dyne psychrometer. The wet and dry bulb thermometers of the psychrometer are certified by comparing their readings with an NIST-traceable Brooklyn thermometer, Serial number 6D619. The psychrometer is recertified each year.

## 6.2 PERFORMANCE AUDIT PROCEDURES

As stated previously, AVES conducts performance audits in accordance with procedures described in the EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volumes I (1984) and II (1987b).

- **NMHC Analyzers**

A multipoint audit will be performed to obtain the analyzer's response to a known input. The audit will be performed by diluting gas concentrations obtained from standard gas cylinders of methane using the Dasibi calibrator. This audit will provide the analyzer response at three evenly spaced span points covering the entire analyzer range and the zero point. The procedures follow the EPA-recommended methods (EPA, 1987b) and are described briefly below.

The audits of the air quality samplers begin with the station technician identifying the appropriate data channel and taking it off line so that ambient data are no longer being collected. The sample line or inlet filter is then connected to the Dasibi calibrator via a vented "T" arrangement that introduces the audit span gas through as much of the normal sampling train (i.e., filters, scrubbers, etc.) as possible. The analyzers are challenged with specific concentrations of span gas as follows:

| Audit Point | Concentration Range (Percent of scale) |
|---|---|
| 1 | .0 |
| 2 | 6% to 16% |
| 3 | 30% to 40% |
| 4 | 70% to 90% |

- **Temperature**

The temperature-sensing systems are audited by immersing the system thermister together with an NIST-traceable mercury-in-glass thermometer in the same water bath and comparing the readings of the thermometer with the DAS at three temperatures across the normal operating range of the system.

- **Flow Meters**

The performance of ROOTS® meters and other any other flow devices will be audited using an appropriate laminar flow element (LFE). The LFE will be placed in-line with the Roots meter. Measured audit flow rates will be compared the flow rates supplied by the site technician. Site comparison flow rates should correspond to the flow rates used to calculate sample concentrations. The ambient temperature and atmospheric pressure will be recorded for each flow rate audited, allowing audit flow rates to be reported in either volumetric or standard units, using the following equations:

$$Q_{std} = Q_{vol} \text{ x } (P_a / 29.92) \text{ x } (298 / T_a)$$

$$Q_{vol} = Q_{std} \text{ x } (29.92 / P_a) \text{ x } (T_a / 298)$$

where $Q_{std}$ is the flow rate at standard conditions (P = 29.92” Hg, T = 298°C)
$Q_{vol}$ is the volumetric flow rate
$P_a$ is the ambient pressure in inches of Hg
$T_a$ is the ambient temperature in °C

- **Relative Humidity**

Relative humidity is audited by calculating the equivalent station dew point temperature from the station relative humidity and temperature readings and comparing this value with the audit dew point temperature. The audit dew point temperature is calculated from measurements of the wet bulb and dry bulb temperatures of the NIST-traceable thermometers installed in a Psychro-Dyne motorized psychrometer and the barometric pressure provided by a Peet Brothers, Ultimeter Model 3 electronic barometer.

- **Pressure Transducers**

Output from the pressure transducers will be audited by teeing in an incline manometer and comparing the transducer reading with the manometer reading

- **Barometric Pressure**

Barometric pressure sensors are audited by a one-point ambient comparison with an audit barometer. The audit barometer is a Peet Brothers Ultimeter Model 3 electronic altimeter/barometer.

- **Data Acquisition System**

Audit of the strip chart recorders and data loggers will be performed as part of the instrumentation audit. Since all instrument audit responses are synonymous with data system response, data system responses are audited as the various instruments interfaced with the data system are audited. The strip chart recorders and data loggers will be checked for proper data scanning frequency and clock time.

## 6.3 SYSTEMS AUDIT

AVES's quality assurance department will perform a systems audit in conjunction with the performance audit. The EPA has established guidelines for installing and operating air monitoring programs to assure the collection of accurate, complete, and precise data (EPA, 1987). In addition, vapor recovery test procedures are specified in TP-201 (ARB, 1996). A systems audit verifies that these guidelines and procedures are being adhered to and that data of acceptable quality can be collected. It is a qualitative appraisal of the quality assurance/quality control systems used for each monitoring sensor.

During the systems audit, the overall organization and operation of the monitoring program is examined. This includes evaluating sample flow requirements, sampling probe location, calibration and instrument check procedures, data-processing procedures, instrument operating range, and quality control procedures and methods. In addition, system components will be checked for conformity with TP-201 procedures. The audit will be performed using a checklist to document audit findings and provide a standardized method for performing the systems audit.

Upon completion of the systems audit, the auditor will prepare a report detailing deficiencies found during the audit. In the report, he will, if necessary, recommend actions required to improve the project and to meet regulatory agency guidelines. Included in the report will be copies of the systems audit checklist.

Quality assurance will be performed by AVES's Quality Assurance (QA) department. The QA department is an independent section of AV and reports findings directly to the project manager. QA will include both a system audit and a performance audit.

# SECTION 7

# REPORTING

## 7.1 DATA REPORTING

After each test series, preliminary data reports will be prepared by AVES and sent to AVES project manager. The data report will include a description of the measurements and data precision, completeness and blank filter analysis results.

At the end of the ORVR impact retest series field program, the preliminary data will undergo further validation in preparation for data analysis. Upon completion of this validation task, data analysis will be executed. The results of this effort will be summarized in a project progress report and sent to the technical advisor panel.

At the conclusion of all data analysis activities, a draft final report will be completed and submitted to the TAP for review in a format specified by ARB. Upon receiving their comments, the project final report will be completed.

Monthly progress reports will continue to be send to the ARB project manager describing progress to date, expected action items for the following month, and problems or concerns.

# SECTION 8

## CORRECTIVE ACTION

Corrective action will be initiated whenever a problem is identified. The goal of corrective action is to remedy any problem before the project or equipment and/or parameters drop below the desired accuracy, precision, or completeness.

The data polling scientist or instrument technician are the primary individuals on this project for identifying problems and initiating corrective action. The local site operator is secondary on this project for identifying most problems except for those problems that can only be identified by visual site inspection. Once a problem has been identified, the person who found it will either fix it himself or request the project manager for assistance.

Whenever a problem is identified, the project manager will be notified. A computerized copy of the action report will be filled out using AVES's computerized problem reporting system. The problem reporting system assures completeness of documentation and automatically notifies (computer mail) all project personnel about the problem. The project manager is responsible for appropriate action to maintaining the monitoring objective. For instance, in order to maintain the 80 percent hydrocarbon sampling completeness goal, if the data poller or site operator find the analyzer inoperative, the project manager will take action to prevent more than six days of lost data in a month.

## SECTION 9

### 9.1 SCHEDULE

The proposed schedules for the baseline and ORVR impact test series are illustrated in Table 9-1. All pretest activities will be conducted and completed by 14 July 1998. The beginning of the baseline test series will ensue 17 July 1998 for each field test site and continue for 14 days. The ORVR impact test series will begin at both test sites on 31 July 1998 and will last for 96 hours. Data analyses will be executed concurrently with the baseline and ORVR impact test series. It is anticipated that data analyses will be complete 7 August 1998. The draft final report will be delivered to ARB staff on 11 August 1998.

# SECTION 10

## REFERENCES

40 CFR 58 (1987): Code of Federal Regulations: Protection of the Environment, Title 40, Parts 53 to 60.

Environmental Protection Agency: QA/QC Requirements for Reviewing the Data Generated by Responsible Parties. Unnumbered and undated EPA document.

Environmental Protection Agency (1987a): Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD). EPA Document EPA-450/4-87-007.

Environmental Protection Agency (1987b): Quality Assurance Handbook for Air Pollution Measurement Systems Vol. II, Ambient Air Specific Methods. EPA Document EPA-600/4-77-027a.

Environmental Protection Agency (1984): Quality Assurance Handbook for Air Pollution Measurement Systems. Vol. I, Principles. EPA Document EPA-600/9-76-005.

Environmental Protection Agency (1980): Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans. EPA Document QAMS-005/80.

# APPENDICES

## Appendix A

## TP-201.2

## Determination of Efficiency of Phase II Vapor Recovery Systems of Dispensing Facilities

## Appendix B

## TP-201.2A

## Determination of Vehicle Matrix for Phase II Vapor Recovery Systems of Dispensing Facilities

**Appendix C**

**TP-201.2B**

**Determination of Flow Versus Pressure for Equipment in Phase II Vapor Recovery Systems of Dispensing Facilities**

**Appendix D**

**1998 Models Equipped with ORVR Systems**